

## CLAIMS

What is claimed is:

1. A method for making an electrochemical cell, comprising the steps:
  - a. forming a curable PFSI electrolyte comprising the steps of:
    - 5 i. mixing a perfluoro sulfonate ionomer (PFSI) with a monomer and a cross linking agent having at least two vinyl functionalities forming a mixture;
    - ii. removing the solvent of the PFSI by distillation to obtain a curable PFSI electrolyte;
  - b. disposing the curable PFSI electrolyte on a first electrode and a second electrode  
10 forming a precursor; and
  - c. treating the precursor to cure at least a portion of the curable PFSI electrolyte forming a cured electrolyte composition.
2. The method of claim 1, wherein the cured electrolyte composition comprises a gel.
3. The method of claim 1, wherein the cured electrolyte composition comprises a solid.
- 15 4. The method of claim 1, wherein the cured electrolyte composition comprises a liquid with viscosity higher than the curable PFSI electrolyte.
5. The method of claim 1, further comprising the step of adding an initiator to the mixture and then forming the precursor and treating the precursor with a procedure selected from the group consisting of photo-curing and thermal curing and combinations thereof.
- 20 6. The method of claim 1, wherein the treating of the precursor is performed with electron bombardment.
7. The method of claim 1, further comprising the step of adding solvent to the mixture.

8. The method of claim 1, further comprising the step of adding an elastising agent to the mixture.
9. The method of claim 1, further comprising the step of inserting at least one spacer between the first and second electrodes forming a cavity adapted to receive the curable PFSI electrolyte.
10. The method of claim 9, wherein the curable PFSI electrolyte is disposed in the cavity by a method selected from the group consisting of pouring the curable PFSI electrolyte into the cavity, pumping the curable PFSI electrolyte into the cavity, injecting the curable PFSI electrolyte into the cavity, and combinations thereof.
11. The method of claim 1, further comprising the steps:
- a. forming a channel in a porous substrate wherein the channel comprises a first channel wall and a second channel wall;
  - b. forming the first electrode in the first channel wall;
  - c. forming the second electrode in the second channel wall; and
  - d. disposing the curable PFSI electrolyte in the channel in communication with the first and second channel walls.
12. The method of claim 11, wherein the cured electrolyte composition comprises a gel.
13. The method of claim 11, wherein the cured electrolyte composition comprises a solid.
14. The method of claim 11, wherein the cured electrolyte composition comprises a liquid with a higher viscosity than the curable PFSI electrolyte.
15. The method of claim 11, further comprising the step of adding an initiator to the mixture, forming the precursor and treating the precursor with a procedure selected from the group consisting of photo-curing, thermal curing and combinations thereof.

16. The method of claim 11, wherein the treating of the precursor is performed with electron bombardment.
17. The method of claim 11, further comprising the step of adding solvent to the mixture.
18. The method of claim 11, further comprising the step of adding an elastising agent to the mixture.
19. The method of claim 11, wherein the precursor is formed by disposing the curable PFSI electrolyte into the channel by impregnating the curable PFSI electrolyte into the channel using a flat blade, pouring the curable PFSI electrolyte into the channel, pumping the curable PFSI electrolyte into the channel, injecting the curable PFSI electrolyte into the channel, or combinations thereof.
20. The method of claim 11, further comprising the steps of :
- a. forming in the porous substrate a plurality of channels, wherein each channel comprises a primary channel wall and a secondary channel wall;
  - b. forming in each channel of the plurality of channels, a primary electrode in the primary channel wall and a secondary electrode in the secondary channel wall; and
  - c. disposing curable PFSI electrolyte in each channel wherein the curable PFSI electrolyte is in communication with the primary channel wall and the secondary channel wall.
21. The method of claim 20, wherein the cured electrolyte composition comprises a gel.
22. The method of claim 20, wherein the cured electrolyte composition comprises a solid.
23. The method of claim 20, wherein the cured electrolyte composition comprises a liquid with a higher viscosity than the curable PFSI electrolyte.

24. The method of claim 20, further comprising the step of adding an initiator to the mixture, forming the precursor and treating the precursor by photo-curing, thermal curing, or combinations thereof.

25. The method of claim 20, wherein the treating of the precursor with electron bombardment.

26. The method of claim 20, further comprising the step of adding solvent to the mixture.

27. The method of claim 20, further comprising the step of adding an elastising agent to the mixture.

28. The method of claim 20, wherein the precursor is formed by disposing the curable PFSI electrolyte into the channels by a method selected from the group: impregnating the curable PFSI electrolyte into the channels using a flat blade, pouring the curable PFSI electrolyte into the channels, pumping the curable PFSI electrolyte into the channels, and injecting the curable PFSI electrolyte into the channels, and combinations thereof.

29. The method of claim 20, further comprising the step of:

a. attaching a base to the porous substrate, wherein the base comprises :

i. at least one distribution plenum;

ii. at least one master port adapted for receiving the curable PFSI electrolyte; and

iii. at least one fluid port for each of the plurality of channels adapted for transporting curable PFSI electrolyte from the distribution plenum to each channel;

b. inserting the curable PFSI electrolyte into the at least one distribution plenum through the at least one master port; and

c. flowing the curable PFSI electrolyte through the at least one distribution plenum and out the at least one fluid port into each of the channels.

30. The method of claim 29, wherein the inserting of the curable PFSI electrolyte comprises using a technique selected from the group consisting of injection insertion, pressure application, pouring, vacuum pulling, centrifugal forcing, and combinations thereof.